

RAILWAY ENGINEERING

and Maintenance of Way

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Vol. 1.

CHICAGO, OCTOBER, 1905.

No. 7.

Temperature in New York Subway

THE engineers in charge of Subway encountered and overcame some very stiff problems during the location of the line, and now that it is completed from the Bronx to the Battery, there is one difficulty not reckoned with, and one that is quite likely to test the ability of those concerned, to the limit, before it is adjusted to the satisfaction of the patrons of the underground line. It is a question of temperature that has baffled the genius of the engineers thus far. No one expected the Subway to be warmer than the streets above, while the bore was under construction, but such has proved to be the situation, and now experiments are in order to get a move on the stagnant air. To do this, immense exhaust fans have been installed. The fans produce motion in the air, but the temperature is not lowered. A refrigerating plant would appear to be the thing to satisfy the conditions.

Reinforced Concrete Construction

THE observer of the trend of bridge and trestle construction is not surprised at the fact that a new and successful rival to old time materials in engineering has forced its way to the front and made a

place there for itself which is to be unassailable and permanent. Wood is out of it for all purposes except preliminary work. Stone which is of unquestioned durability, and also steel, are both materials of construction which will soon be numbered with things obsolete, with the possible exception of the latter, in special cases of immense span. Concrete is the new agent that has worked the undoing of the old materials of engineering in many places, and it has done this so rapidly and quietly on its merits as to earn the distinction of standard practice on many prominent lines.

In the September issue of Railway Engineering mention was made of a plain concrete bridge on the Illinois Central, having three double track arches of 140 ft. span. The same road has now under construction two single track trestles with five half elliptic arches of 14 ft. span, both of which are of reinforced concrete. The Illinois Central is one of the earliest experimenters in concrete work, both plain and reinforced, and must therefore be in possession of reliable data concerning the value of such form of construction. That such is the fact would appear from the pains taken to design these trestles with a closer regard for the theory of stresses than has been the case with some designers who seem to have been wedded to the idea that any kind of metal, or disposition of same would answer for purposes of reinforcement.

Rail Elevation on Curves

THE report of the committee on "Track Surface and Line," which was made at the convention of the Roadmasters' and Maintenance of Way Association at Niagara Falls, was received with the consideration it was entitled to as one of the best papers presented at that meeting, and even while there were some differences of opinion frankly expressed in the discussion, there was no doubt of the body being in accord with the recommendations of the report. In the section referring to elevation on curves, the committee placed the maximum height at seven inches for all speeds and degrees of curvature, the report in this connection reading as follows: "Since the elevation required is a function of, and depends upon the speed of trains, this speed is the first element to be considered. In general, as a matter of safety, the preference should be given to the fast passenger trains. Ordinarily an elevation of seven inches will not be exceeded, and speed of trains should be regulated to conform to this elevation."

The above finding is the result of careful thought of practical men, and as such should have weight, but the fact remains that the speed of trains are not and never have been regulated to conform to either curve or elevation, though safety should be the first consideration, as was plainly stated in the report. That safe speeds on curves are exceeded, is felt too often by the passenger, in the violent surge due to the effort of the

train to follow a tangent, and the stand of the committee to neutralize this centrifugal force by a reduction of speed to the safety point, is a timely one.

There is not much space in the report devoted to widening of gage on curves; the paragraph referring to this part of the subject reading as follows: "The gage must be kept uniform throughout and must not be widened through frogs or switches or any other point, unless it be around very sharp curves. The widening of gage on curves is a function of the degrees of curvature, just as the elevation of the outer rail is a function of the speed, having as important a relation to the economy of haulage and flange and rail wear, as the elevation bears to the question of safety. Since there is so much indefinite information on the actual amount of resistance per degree of curve, and the effect of each increment of widening per degree, some new facts, on these points, if such exist, would have been a valuable addition to this excellent report.

Elevated and Subway Roads in Phila- delphia

PHILADELPHIA, with her population of 1,300,000 souls, has, like her sister cities, New York, Chicago and Boston, suffered from a want of proper transportation facilities, and has, like them, set about to relieve traffic congestion by means of elevated and subway railways; the surface lines having long since proved unequal to the task of coping with the immense volume of travel. The system as planned and now approaching its finish, consists of two lines at right angles with each other, passing under Broad and Market streets at the points of densest traffic. The line on Broad street is a subway, while that on Market street is a combined subway and elevated road, being in this particular similar to the Bronx branch of the New York subway which becomes an elevated road after passing under the Harlem river.

The opening operations in Philadelphia were begun

on the subway at Market street on the west side of the City Hall fronting the station of the Pennsylvania road, passing west under Market to the Schuylkill river, and crossing a bridge at that point becomes an elevated line to Sixty-third street. A loop at the City Hall connects the two system, giving access to all points in combination with the surface lines, which they are designed to renew.

No serious engineering problems have pressed for solution in the construction of these new arteries of travel, the excavation being principally through earth and gravel. Drainage, however, occupied the attention of the constructors, surface water having to be provided against, which is handled by ordinary drain pipes and a sump from which the water is removed by an electric driven centrifugal pump. The builders of this subway have profited by the difficulties which developed in the ventilation of the New York project, in which the expected automatic piston action of the trains to induce air circulation proved to be a broken reed.

The Philadelphia subways will be distinguished by an original attempt to have air at least as pure as that on the surface, and this is based on the amount of air required per passenger. To have the required ventilation pockets are let in along the sides, having communication

with the outside of the bore, in connection with which there is a ventilating stack to produce by natural draft a displacement of the vitiated subway air. In these pockets, and also at the base of the stack, will be located fans, in the event the stack and ventilating shafts fail to do what is expected of them. The performance of this method of ventilating a bore will be observed with much interest my engineers for the reason that what was regarded as of insufficient cause for serious thought in this direction in New York, proved to be one of the most vexatious questions to handle after the subway was completed.



MR. R. K. SMITH.
GENERAL MANAGER, D. T. & I

Mr. Smith was born on February 22, 1869, and entered railway service as telegraph operator with the Union Pacific in 1887. During 1888 and 1889 he was agent and operator with the Wabash, St. Louis & Pacific at various points, and from February, 1890, to July, 1894, was contracting freight agent of the Burlington System at Kansas City, Mo. From July, 1894, to November, 1899, he was successively general agent of the same road at Atchison, Kan., and traveling freight agent, Leavenworth, Kan. In November, 1899, he was appointed assistant superintendent of the Kansas City, St. Joseph & Council Bluffs, which is a part of the Burlington System, and in October, 1902, he accepted the superintendency of the Missouri division of the St. Louis, Iron Mountain & Southern, which position he resigned June 12, 1905, to become general manager of the Detroit, Toledo & Ironton, formerly the Detroit Southern.

Convention of the Roadmasters' and Maintenance of Way Association

THE Roadmasters' and Maintenance of Way Association held its twenty-third annual convention at Niagara Falls, N. Y., Sept. 12 to 14, inclusive, the sessions being held in the Cataract House. After the usual address of welcome, President Blue, on opening the convention to business, gave many interesting statistics showing the value of the Association to railways, and also touched upon the impossibility of executive officials to make a successful administration without the co-operation of skilled brains. The first paper presented was that on hand cars, which was read by Secretary Jones of the C., B. & Q., and passed upon by paragraphs. Mr. Buhner of the Lake Shore, was of the opinion that a hand car for section purposes should not weigh more than five hundred

The secretary also read a paper by Mr. Sampson, on methods of handling rails and respacing ties, in which it was recommended that rail laying be done by gangs of about forty men. The same recommendation was made by Mr. Kline in his paper, also read by the secretary, the ground being taken that one foreman cannot successfully handle a gang of a greater number of men. With such a gang it was thought that one-half mile of track per day could be laid. In the discussion of these papers, Mr. Foley stated that he unloaded rails from flat cars by dropping them, and lifted them from gondola cars with a rail unloader, while from box cars it was his practice to remove them by dragging out, being aided in the work by a snatch rope. He believed that better method of laying rails was to splice them in numerous lengths rather than to lay them singly. In unloading



R. C. McCLOY, J. M. LALLY, A. M. CLOUGH.

pounds, in order to be easily handled on and off the track. Mr. Foley of the Michigan Central was of the belief that hand cars of a capacity for eight or ten men was sufficiently heavy to handle in section service. Secretary Jones was of the opinion that a car made to carry from three to seven men was heavy enough, since section crews seldom comprise ten men.

The clause in the paper referring to the employment of hand car inspector whose duties should be to note the condition of hand cars, and when necessary make repairs on such cars, awakened considerable discussion, in which it developed that not many section foremen had the ability to make repairs, and that some roads provide for the situation by employing a mechanic to keep hand cars in repair. Mr. Boyce, of the Mexican National Ry., said his road solved the problem, by the assignment of a carpenter and blacksmith in his bridge and track department to the repair of hand cars and section tools.



C. L. OKELL, S. W. HAYES, GEO. L. GIFFORD.

rails, he removed the loads from six to ten gondola cars of 60,000 to 80,000 lbs. capacity, in ten hours, with six men and the unloader referred to. Mr. Buhner stated that the cost of unloading 100 pound rails from gondola cars by hand exceeds \$100 per mile of track. Mr. Foley removed rails from high side gondola cars to flat cars with a steam derrick before leaving the yard. It required a gang of six men with the derrick car to unload about six cars per day, about \$25 being the cost of the operation. From two to three miles of track per day is dropped from the flat cars, depending on the length of time the line is clear. Mr. Hayward, of the C., B. & Q., had unloaded from stock cars rails for two miles of track, with a gang of eleven men, at a cost of \$17, this cost being exclusive of that of the train crew. In a comparison of notes by the members, it was found that the cost of track surfacing and tie respacing after the laying of new rails, covered a range of from \$175 to \$260 per mile.



EXHIBIT OF BUDA FOUNDRY & MFG CO.

The paper on wood, metal and composition ties, by Mr. McNeill, of the A., T. & S. F. Ry., was read by the secretary, on the opening of the second day's session. The contention was made that metal and composition concrete steel ties have not established their fitness to supersede the wooden tie. Good results have been obtained by the chemical treatment of ties, in which the creosote treatment is very efficient, though the use of zinc chloride has perhaps a wider application in American practice. It was the opinion of the author that the wooden tie should be conserved, as we must look to it for the present as the most suitable track support. Mr. West, of the A., T. & S. F. Ry., stated that the zinc chloride treatment of pine ties gave them a life of ten years in the track. His experience was that ties so treated corroded the spikes very seriously and also attacked the flanges of the tie plates. With reference to



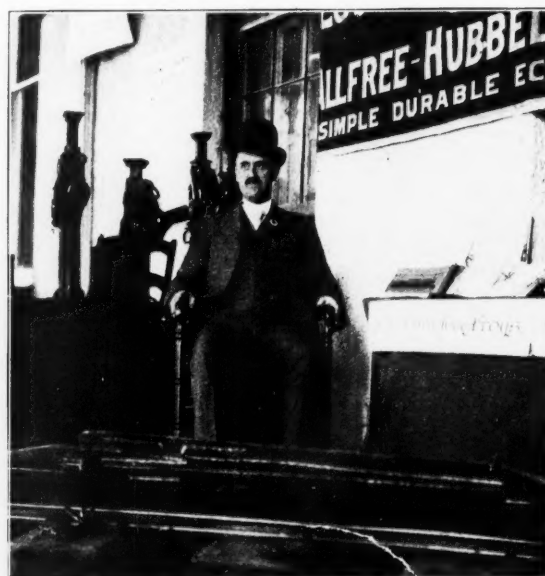
J. W. THORN, J. MCKINNON.

an Arizona pine tie which Mr. Buhrer placed in evidence, and which was suffering from rot, Mr. West explained that the tie had no doubt been laid on a sandy roadbed, where treated ties do not have as long a tenure of life as on other soils. It is necessary to plate all such pine ties on curves of more than three degrees, to make them hold to gage. He thought it the proper procedure to treat ties with the zinc tannin process, costing about 12 cents per tie, while the cost of the creosoted tie is about 36 cents. Mr. Boyce experimented with creosoted Texas pine ties, which untreated are only good for one and half to two years, if therefore their life can be extended to four or five years by treatment, it would plainly be a paying investment.

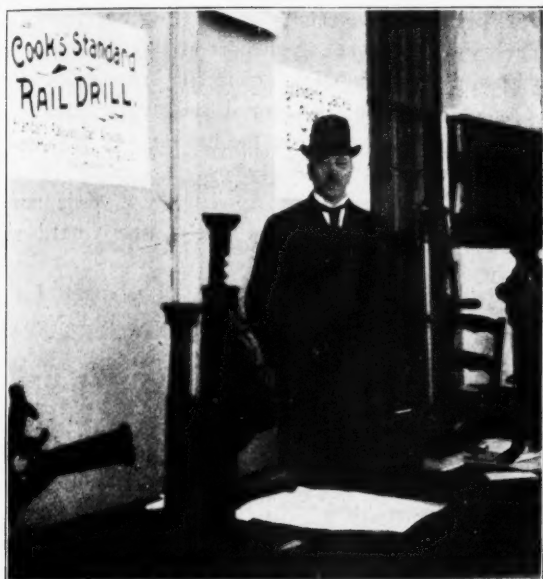
Discussing tie plates, Mr. Buhrer took an emphatic stand against the flanged tie plate. He had found that



S. W. HAYES AND EXHIBIT OF HAYES TRACK APPLIANCE Co.



W. H. ENGLAND AND EXHIBIT OF LOCOMOTIVE APPLIANCE CO.



MR. EUGENE COOK AND EXHIBIT OF THE STANDARD RAILWAY TRACK APPLIANCE CO.

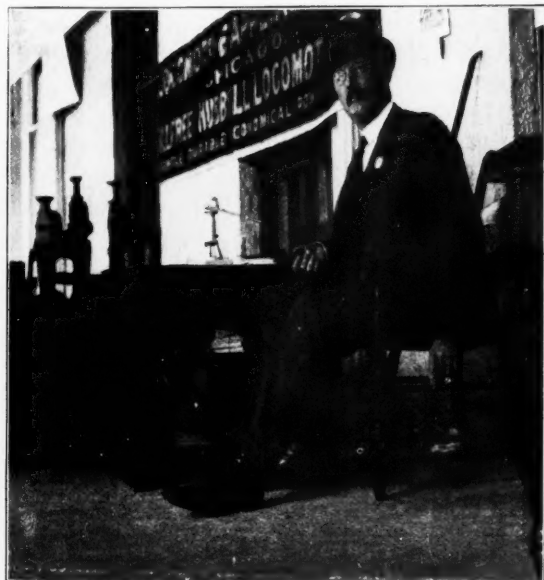
the tie rots quicker under the plate than outside of it, and that the flanges by working in the tie cut from it a piece of the wood, showing an oak tie which had been in service four years, as an object lesson. The position of the speaker was sustained by Mr. West, he having found rotted timber under flanged tie plates. His company had taken up the flat bottom tie plate, which, however, are not faultless, as they rattle badly when loose. He believed that a small claw which would hold the tie plate until it became imbedded in the timber, would obviate the difficulty now found in the plain plate. Mr. Hayward had found white oak and burr oak ties cut down three inches in a period of six months, under switch leads, where the service was heavy switching. By the use of three-eighths plates he was able to more than double the life of these ties. During the discussion of this



MR. R. L. BROWN AND EXHIBIT.

question Mr. Buhner contended that the rotting of the tie having flanged plates was hastened by the letting in of water at the flanges. Mr. Morrison took issue with this statement, saying that the tie shown by Mr. Buhner was a fine sermon on the efficiency of the flanged tie plate. He was certain that the plate had become solidly fastened to the tie, and that the unsound fiber was the fault, from decay of the heart, and not the fault of the plate. The consensus of opinion was favorable to the use of tie plates. The subject was deemed of such importance by the president as to warrant carrying over until the next convention.

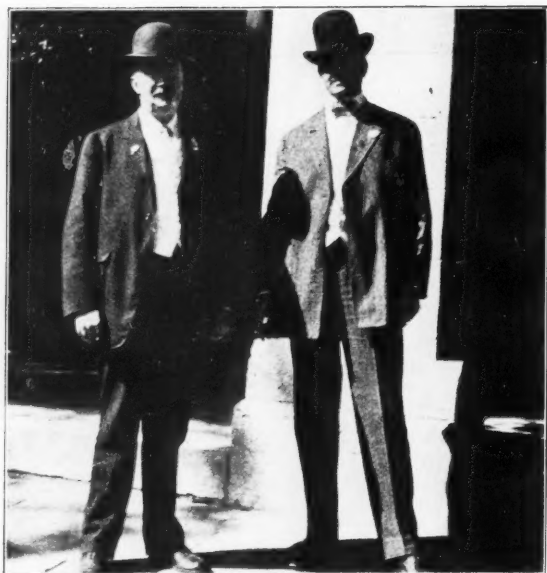
The closing day of the convention was characterized by the reading of several important and interesting papers, among which was one by E. E. R. Tratman, editor of the Engineering News, on "Switches and Frogs and



MR. PHILIP J. MITCHELL AND EXHIBIT OF PHILIP S. JUSTICE & CO.



C. L. OKELL, J. ENNIS AND EXHIBIT OF WALTERS & OKELL.



W. T. SMETTEM AND J. ALEXANDER BROWN.

Switch Protection"; one by Mr. A. Morrison, of the Pennsylvania road, on "The Construction and Maintenance of Railroads Capable of Taking Care of the Present Traffic and Rolling Equipment"; and one by Mr. W. M. Camp, editor of the *Railway and Engineering Review*, on "Some of the Advances in the Improvement of Track." Besides these, there was a discussion of the paper track surface and line, for which there was nothing but commendation. The discussion was confined principally to the elevation of curves, in which the recommendation of the committee was for 7 inches as a maximum. It was noted that while there was a difference of was required for certain speeds, it would be better practice to reduce the speed, and not exceed the stated maximum. It was noted that while there was a difference of opinion, the speakers generally were in accord with recommendations of the committee.

There were many pleasurable features connected with this convention, among which were the sight-seeing trips around this greatest of all of Nature's attractions. One of these that will leave a most lasting impression on the visitors, however, was the visit to the Ramapo Iron Works, where refreshments were served each day of the convention.

The roster of officers for the following year is as follows:

President, C. Buhrer, L. S. & M. S. Ry.

First vice-president, W. E. Emery, C. & N. W. Ry.

Second vice-president, W. A. Brant, Iron Mountain Ry.

Secretary and Treasurer, C. E. Jones, C., B. & Q. Ry., re-elected.

Members of Executive Committee—J. A. Kerwin, Iron Mt. Ry.; C. B. Teller, C. & W. I. R. R.

Chicago was selected as the place of the next annual convention, and the time of meeting, on the second Tuesday in November.

Railway Supply Exhibits at Niagara Falls

The exhibits of track appliances at the convention of the Roadmasters and Maintenance of Way Association at Niagara Falls was the largest and most complete of any ever before presented at the meetings of that body, as the following mention will show:

Standard Railroad Track Appliance Co., Kalamazoo, Mich.—Cook's Radial Drill, Patent Cattle Guard and Jacks.

Fairbanks, Morse & Co., Chicago, Ill.—Barrett Jacks. Locomotive Appliance Co., Chicago, Ill.—Newton Wrecking Frogs; Smythe Derailer;

Philip S. Justice, Philadelphia, Pa.—Reliance Hydraulic Jacks.

U. S. Metal & Mfg. Co., New York, N. Y.—Columbia Lock Nut.

Perfect Pressed Steel Car Replacers; Victor Cast Steel Car Replacers, New York, N. Y.

Waters' Ballast Placing Device, Fort Madison, Ia.

Hayes Track Appliance Co.—Hayes Derailer, Geneva, N. Y.

Handlan-Buck Co., St. Louis, Mo.—Mitchell's Switch Points; Handlan Switch Stands; Noble's Safety Switch Rail Lock.

Wm. Wharton & Co., Philadelphia, Pa.—Wharton Unbroken Main Line Switch; Manganese Steel Frog.

Wm. Goldie, Jr., & Co., West Bay City, Mich.—Girder Rail; Tie Plug.

Continuous Rail Joint Co. of America, Newark, N. J. Grip Nut Company, Chicago, Ill.

Dressel Railway Lamp Works, New York, N. Y.—Herculean Signal Lamp.

Scott Mfg. Co., Racine, Wis.—Racine Rail Anchor; Hercules Bumping Post.

Louis Mueller, Owosso, Mich.—Truss Support and Rail Joint.

The Independent Supply Co., Chicago, Ill.—Wollhaupter Rail Joint.

Wire Railroad Fencing, New York-Chicago.

McCann & Brossel, Sault Ste Marie, Mich.—Rail Chair and Joint.

The Smith Curve Lining Gage, Chicago, Ill.

Handlan-Buck Co., St. Louis, Mo.—Lamps, Track Drills.

The Hunt Steel Co., Elyria, Ohio.—Rolled Steel Tie Plates.

Atlas Railway Supply Co., Chicago, Ill.—Rail Joints; Switch Stands.

Avery Stanfair Co., Cleveland, Ohio.—Shovels; Steel Ties.

Elliott Frog & Switch Co., East St. Louis, Ill.—Frogs and Switches.

R. L. Brown, Chicago, Ill.—Switch Stands.

American Valve & Meter Co., Cincinnati, Ohio.—Switch Stands.

Buda Foundry & Mfg. Co., Chicago, Ill.—Jacks; Ground Switches; Semaphores; Car Replacers; Track Drills; Handcar Wheels; Handcars; Track Gages.

Indianapolis Switch & Frog Co., Springfield, Ohio.—Frogs; Switches.

Some of the Advances in the Improvement of Track

By W. M. Camp, Editor of the Railway Review.*

IT is profitable study to follow the progress in any line of engineering work, and a retrospect of railroad track for any considerable period is no exception to this rule. When one comes to consider the great amount of capital invested in track construction, the large annual outlay for repairs and improvements, the large army of men required to perform the necessary labor, the special conditions to meet and the difficulties to be overcome, in order to maintain track in desirable condition for traffic, at economical expense, he finds that track work is one of the most important of engineering industries. As with other lines of engineering work, the track has been greatly improved, with time, and a gradual development in provisions for safety and in methods of economy is all the while proceeding. While the type of construction has remained unchanged for a long time, the advancement in design, in the quality of materials and in methods of work has been striking and well worthy of careful study.

The first track built for a common carrier railroad in this country was in the fall of 1829, in the city of Baltimore, when tracklaying was commenced on the Baltimore & Ohio railroad, and it will be worth our attention to consider the particulars of that historical event. The chief engineer was Jonathan Knight. The man who ran out the line and set stakes for the grade was Lieut. Geo. W. Whistler, of the United States army. The superintendent of construction was John Ready. The foreman was Thomas McMachen, who was probably the first track foreman in this country. The laborers on this occasion were four carpenters, and, as they constituted the first track crew, their names ought also to receive mention, and they were Alfred Ray, Nicholas Ridgley, Silas Fickett and a young man named Wendel Bollman. This man Bollman, by the way, later became "master of road" of the Baltimore and Ohio system, and if he was not the first man in the country to bear the title of "roadmaster" he was certainly one of the first. He remained in the employ of this company for more than 30 years and was the inventor of the Bollman bridge truss, so long a standard type of bridge construction on American railroads. Another man connected with this early construction work of the Baltimore & Ohio R. R., in the capacity of assistant engineer, who later became famous in railroad history, was Mr. Benjamin H. Latrobe.

The first rails were laid on longitudinal wooden sleepers, but in the 11¾ miles of road constituting the first division there was an interesting variety of construction. There was strap iron rails on granite longitudinal sills, rails laid on longitudinal timbers supported on stone blocks, rails on longitudinal timbers supported on broken stone, rails on longitudinal timbers supported by cross ties, and wrought iron rails of English manu-

facture, all in service as early as the year 1832. Before construction was begun at all Chief Engineer Knight and a party of engineers, several of whom had been detailed from the army engineer corps, had visited England and had examined every railroad of consequence in that country. It was therefore but logical that they should apply whatever knowledge had been derived from experience with work of this character which they had investigated.

These details of history are related to show that the construction of this road was not undertaken in a haphazard manner, but according to well studied engineering plans. The charter had been obtained and the company organized in 1827. The corner stone laying on July 4 of the following year was a formal event, accompanied by a magnificent parade of civil and military organizations and other displays; and all the work of preparing the road for traffic was deliberately carried out. The fact that this first construction of the Baltimore & Ohio R. R. included a cut 78 feet deep and 3,900 feet long is evidence that the road was intended for something more than a mere experiment, and the types of track laid down were used as examples of the best construction which the previous experience of England had afforded. Such was representative of track construction at the outset of railroad building in this country, 76 years ago.

In the early days of railroading stone blocks were widely considered the best means of track support. George Stephenson, the great developer of the steam locomotive, long thought that cast iron rails in 15 ft. lengths, supported on stone blocks 2 ft. square, was the most serviceable form of track construction. Several of the early railroads of this country tried stone supports, but it cannot be said that their use became extensive in any general sense. Timber longitudinal, cross timbers or ties, and various combinations of the two, were adopted in preference. Strange as it may now seem, plain cross ties supported directly upon the roadbed were not widely in favor at the first. There were numerous designs of cross ties laid on trenches filled with broken stone or other material, cross ties on longitudinal sleepers, cross ties on the tops of posts set in the ground, and several miles of the Erie R. R. was built with rails direct on the tops of driven piles cut off to grade.

The T-rail, like the simple cross tie, did not immediately come into general use after its invention by Mr. Robt. L. Stevens, an American, in 1830, almost co-existent with the beginning of railroad construction in this country. After thorough trial of almost every conceivable combination of wood and iron, for the purpose, however, the plain T-rail laid direct on cross ties became the prevailing type of track construction in America, and eventually the exclusive type, and so it remains until this day throughout almost the entire world. That it has come down to us as the "survival of the fittest" is a firmly established fact in history. The mileage of track built on different plans, such as

*Read before the Roadmasters' and Maintenance of Way Association, at the twenty-third annual convention, Niagara Falls, N. Y., Sept. 12-14, 1905.

on longitudinal sleepers or on pots or bowls, is too insignificant to be taken into account. The only important modification of this simple construction worth noticing is the English design of track, which interposes a chair between the rail and the tie.

The general adoption of the cross tie system of track, with rolled rails, seems to have been the first great advance in track construction. The verdict in favor of this type was certain, and all attempts to repeat history by trials of longitudinal supports have been as short lived as they were ill advised. Thorough trials of every known type of construction had proven the cross tie system the best adapted to drainage, the most flexible arrangement for surfacing, and withal the cheapest to construct and maintain.

In due course fish plates came into general use for joint splices, superseding chairs at the joints, base clamps and some other appliances; and eventually this gave way to the angle bar, a much superior device. Contemporaneous with this advance cast iron frogs were replaced with built-up frogs of rail construction.

It is remarkable that the great improvements in track have been of slow growth. It was some years after steel rails were first rolled before they began to be introduced generally, but at last metallurgy was triumphant and steel rails, vastly superior to the iron rails which they replaced, could be had at a price that was reasonable by comparison. In this it seems that the early metallurgists wrought better than their modern successors. However, the change to steel rails opened up great possibilities in the development of rolling stock. The iron rail was too soft and inadequate to 50-ton locomotives and freight cars of 24,000 lbs. capacity, for the battering action was severe and extremely troublesome, and broken rails were very frequent. It goes without saying that our 100-ton locomotives and 100,000-lb. capacity cars of to-day could hardly be operated satisfactorily on the iron rails that were in general service 35 years ago. The increase in weight of rails, to meet the requirements of heavier rolling stock, is another interesting development. Mr. P. H. Dudley agitated and succeeded in bringing about an increase to 80 lbs. per yard in 1884, and 100-lb. rails, now quite widely found on the heavy-traffic roads, began to be used 8 years later, or 13 years ago. The development in weight of rails has, therefore, largely taken place during the life of the Roadmasters' Association.

The last of the far-reaching improvements in rails was the standardization of sections, credit for which is due to committee work of the American Society of Civil Engineers. The practical advantages of the improvement have been so thoroughly discussed among railway men in recent years and the satisfaction over the results of the change is so widespread that extended comment is uncalled for. The present need seems to be to produce a quality of metal equivalent to the standard of a former excellence which has been lost through development in mill processes to effect increase of output. The

present inferior quality of rail metal is one item of our story for which retrogression is widely claimed in place of an advance. Quite recently the breakage of heavy section rails on several railroads, using rails purchased from different manufacturers, was so numerous that the situation was truly alarming.

Perhaps the slowest in application of the great improvements to track has been the point switch, for it was used to some extent a generation ago and it has not entirely replaced the stub switch at this day, notwithstanding that present standard designs of point switches with wrought strap reinforcement are much stronger and safer than the unprotected points so long in use. The Clarke-Jeffery improvement to the point switch, which seated the point rail over the base of the main rail, was one of those far-reaching advances which comes about from perfection of detail. The development of switches and frogs within recent years has resulted in many safeguards and in stronger and better wearing construction. It will suffice to simply enumerate automatic switch stands, interlocking distant signals, spring frogs, heel risers, frogs with reinforcing rails at the throat, the hardened center for frogs, and the very important set of standard measurements of wheel gage in relation to frog flangeways, wing rails and guard rail gage, adopted by the Master Car Builders' Association.

It is thus seen that one of the most important advances in the improvement of track, namely, the establishment of frog and guard rail gaging points and gaging distances, was by an association not connected with the road department, but with one which has very close relation with that department. In the same connection it may also be noted that the matter of the fixing of standard rail sections came about through the instrumentality of the American Society of Civil Engineers, which is not distinctly a railroad association.

A large number of improvements to track have been brought about so recently that it is unnecessary to comment upon them at length. The treatment of ties with chemicals to preserve them from decay, whereby their life is extended to two or three times the natural life of the timber, has been in course of development during the past twenty years, and is now a firmly established industry with railroads west of the Mississippi river, and with some of the roads running into Chicago. The use of the tie plate on soft wood ties is no longer experimental, and this has now become one of the standard devices in track construction. The improvement in rail-joint splices has been perhaps the slowest of all development, but within the past ten years progress in this line has at last reached a degree of assurance. The now quite general use of easement curves has improved the track for the application of curve elevation, and brought about smoother riding of our fast trains. While the shovel and the pick still remain with us as indispensable articles in the equipment of the section crews, there have been nevertheless many notable improvements in track

tools. We have better hand cars, speedier track drills, rail saws in place of chisels, numerous designs of track jacks in place of raising bars; and generally speaking, tools of more reasonable weight and better designed as to shape since the standards adopted by the Roadmasters' Association some years ago have been followed.

Another important respect in which track work has advanced is in the use of labor-saving devices. Numerous railroads are now equipped with ditching cars and weed burners, and much larger use is made of steam shovels and train plows than was the case one or two decades ago. And one might thus proceed to enumerate other improvements equally as important as some of those already mentioned, but enough has been said to show that extensive changes have taken place in the use of materials of track construction and maintenance, even since the type of construction became a fixture.

The great increase in weight of rolling stock, the growing intensity of traffic, the gradual extension of the mileage of double-track road, and the scarcity of some kinds of materials, have brought about new problems. The creeping of rails, although a trouble not unknown to the trackmen of early years, is now a livelier question than ever before. With a larger mileage of double track, heavier rolling stock and severer conditions in other respects, much study has been given to the problem, and several designs of devices to prevent the trouble of creeping steel are now being applied to track.

At the first annual meeting of this association in St. Paul twenty-two years ago, the first question discussed was substitutes for wooden ties. Even at that day the approaching scarcity of good tie timber was readily seen, but the wooden tie is still the typical track support, and the one almost exclusively used. Continual agitation, however, has brought railway men to a better realization of the situation, with the result that a number of roads, as already stated, have adopted tie-preserving methods as one source of relief, and many roads are now earnestly experimenting with steel ties and combination of steel and concrete ties, with a view to produce more lasting material for track support. It can at least be said that more enthusiasm over substitutes for wooden ties has been aroused during the past five years than could have been predicted from the experience of the country during the fifteen years preceding those five years. The old eight-wheel or American type of locomotive, which formerly was the exclusive type in passenger service, and very largely employed in handling freight, is now rapidly passing into disuse, and in its place we find the heavy passenger locomotive with trailing wheels behind the drivers, and in freight service, the consolidation locomotive. The flanging of all the wheels on these long freight locomotives, as is now the practice on several roads of the country, has been done without careful investigation of the proper relation of wheel gage to track gage in curves. Several questions of rail wear, widened gage on curves, flange wear, and, perhaps, derailments, can be traced to this arbitrary change, and joint investi-

gations by the two departments of railroads, or by associations representing the two departments, should be undertaken.

The increase in the weight of locomotives and the increase in car capacity, has been a source of many questions affecting the economy of track maintenance and safety of operation. Generally speaking, this change has been carried out without going further to investigate the strength of bridges, until it seems that car loads have reached an extremity for which adequate preparation had not been made. At any rate freight car loads have been increased until the wheels are breaking down under them. It has come to be a serious question to get wheels that are strong enough to carry the 100,000 pound capacity cars. The best chilled cast iron, with all the accumulated skill of the wheel manufacturers, has been found inadequate, and freight train derailments caused by broken wheel flanges have been numerous. Whenever positive knowledge of the cause of a derailment has been lacking, and in many cases where an insufficient investigation has been made, it has been customary to lay the blame on "bad track." In case of doubt it is well to look for overloaded car wheels, or for the high 50-ton capacity gondola cars, which become top heavy when overloaded and have been known to rock themselves off their trucks.

It is no disparagement of railway engineering to reflect that the type of track construction has remained unchanged for so long a time. It is well that this construction arrived at the period of a settled type at an early day. We all know that perfection of details cannot be brought about until types have first been adopted. Enough has been said to intimate the character and something of the extent of the development along the lines of perfection of detail. The engineers of the early days conceived many ideas of track construction and made exhaustive trials of the same, which have been proposed or reinvented from time to time during the present generation. Many shapes of rail sections, all manner of cross tie and longitudinal sleeper supports and combinations of the same, multitudes of joint splice designs, numerous kinds of spikes and screw-spikes, fang-bolts and interlocking bolts, many ideas of compound rails and along other lines in which inventors are now active, were experimented with and given up as unsatisfactory at an early day.

In reviewing the improvement of track we must not overlook the influence which has come from the organizations of track officials. The date when roadmasters first gathered together for the discussion of track questions I have not seen stated, but there was an organization of the Roadmasters of the Atlantic & Great Western R. R., (which later became part of the Erie R. R. system) in force as early as 1874, and these men met and published their proceedings annually for eleven years. This organization was due to the efforts of Chief Engineer Charles Latimer, who was known as one of the most studious engineers who have paid attention to track.

Nine years later the Roadmasters' Association, before whom this paper is read, was organized and held its first annual meeting. How the need of such an organization came to be felt and how it was brought about, are known to some of the gentlemen present. The venerable Isaac Burnett, the president of this association at its first annual meeting, and for several successive ones, in his first annual address explained this reason by quoting the scriptural proposition that, "It is not good for man to be alone." During the same year the New England Roadmasters' Association was organized and continued to hold its meetings for some nineteen years.

The effect of the work of these associations on the improvement of track work and methods has undoubtedly been great and lasting. It is certain that the reports presented before the annual meetings, and the discussions of the same, have stimulated thought and advertised widely the best methods and practice which they have brought to notice. Such meetings do not invent new appliances or new methods, but they do make known what is already being done over an extensive field of railway industry. The reports, discussions and papers published in the proceedings of the Roadmasters' Association for the past twenty-two years form a grand array of useful literature for both men of practice and the student. Roadmasters and other maintenance of way men who have joined the association during recent years, should not fail to inform themselves of the past proceedings, and young engineers, beginning in the maintenance of way department can do no better than study carefully and thoroughly the proceedings of the Roadmasters' Association.

The function of the office of roadmaster is highly executive. The officials who take a hand in the legislation for the track department are sometimes many, but it falls to the roadmaster to put the orders into execution and determine their practicability. His opinions are therefore widely sought, whether asked for direct or not. A general manager whose name stands high among railroad men, has said that he liked to read the proceedings of the Roadmasters' Association, because he found there much practical information which he did not like to ask of his roadmasters for fear of exposing his ignorance. On the other hand some roadmasters have been known to say that they gladly embrace the opportunity of taking in the conventions of this association, because there they could express their ideas in general terms, which might be interpreted as personal criticism if repeated in the hearing of their superior officers. There is abundant testimony to show that the publication of these proceedings has been highly beneficial to a large class of readers, and that they have had an important influence in the deliberations incident to general improvement of the track. The advancement of track methods and standards by the work of the association of roadmasters is all the more apparent from the fact that there has been no other source of information of the same class and of equal publicity to take its place.

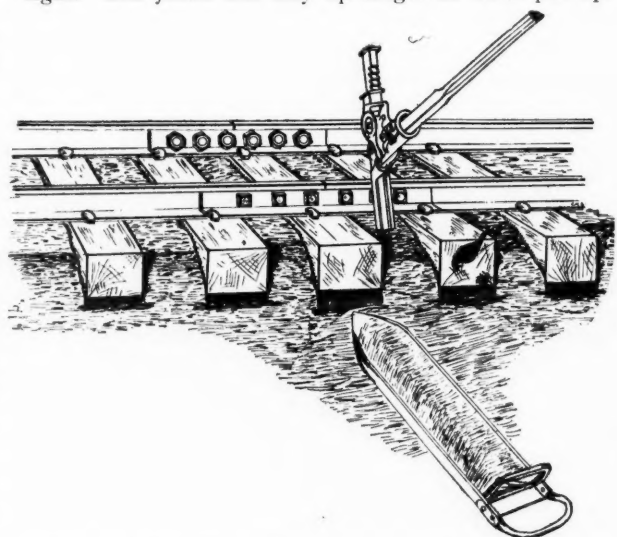
The magnitude of railway mileage is one of the considerations which impress most implicitly on railway managements, the necessity for constant improvement, for a small economy, resulting from improved plans of construction, or a better method of maintenance as applied to a mile of track, may be multiplied into a large sum of money when repeated over the mileage of one of our large railway systems. The accomplishment of such economy is, and always has been, the subject of intense study on the part of the men who have the maintenance of track in charge. These men must study materials and they must study men.

The foregoing account has touched only superficially the ground covered by the problems which have had to be solved to bring the track to its present standard of safety and efficiency, but the field is a broad one, and a complete reference to each and every improvement would involve a very large undertaking indeed. This field of duty has absorbed the thought and lives of many bright and able men, but it has been worthy of their efforts, and the results which we have today, stand for a grand achievement in the progress of civilization.

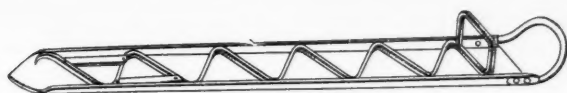
Walters' Ballast Placing Device

THE accompanying illustrations show the Walters' ballast placing device complete. It consists of a long narrow pan and a follower inserted in the pan. The operation is very simple, as all it requires is to raise the track, place the required amount of ballast in the pan and insert under the tie. The pan is then withdrawn, leaving the material on the ground. Withdrawing the follower smooths the ballast, leaving all the material under the tie.

This device has a great advantage over the old system in that it is more rapid, as three men do the work of eight. The joints will stay up longer as when put up



WALTERS' BALLAST DEVICE SHOWING BALLAST REMOVED FROM END OF TIE TO BE RAISED, TRACK JACKED UP AND DEVICE WITH BALLAST ON READY TO PLACE UNDER TIE.



WALTERS' BALLAST PLACING DEVICE.

by the shovel and bar, as the old foundation under the tie is not disturbed, having a solid level base to work on. Being worked from the end of the tie the ballast between the ties is not disturbed, thus not injuring the drainage. There is no chug hole under the tie as the material is placed evenly under the tie an equal distance inside and outside the rail.

It has been found that where a road can secure screen-



WALTERS' BALLAST PLACING DEVICE.

ings to use on top of their road bed that splendid results can be obtained, in fact the work can be done at about one-third the cost of where the material is removed from between the ties and the old foundation under the tie disturbed. In working the machine in this kind of road bed, the rocks from under the tie is removed, the required amount of stone placed on the pan, which is placed under the track. The track is then lowered on this, which will adhere to the solid rock foundation.

This device, as manufactured by Walters & Okell, Ft. Madison, Ia., has been placed in service by twenty railroads in its short career and all report it working satisfactorily.

Superintendents of Bridges and Buildings

THE fifteenth annual convention of the Association of Railway Superintendents of Bridges and Buildings will be held at Pittsburg, beginning on October 17. Headquarters will be at the Monongahela House. The programme includes the following subjects upon which reports will be presented by committees of which the chairman is named:

Construction and Maintenance of Docks and Wharves.—H. Rettinghouse, Wisconsin Central, Fond du Lac, Wis., chairman.

Relative Value of Concrete and Timber Piles.—W. H. Finley, Chicago, chairman.



SHOWING PAN REMOVED, BALLAST UNDER TIE, AND CLEANER READY TO BE WITHDRAWN.

Concrete Building Construction, Including Platforms.—C. W. Richey, Pennsylvania, Allegheny, Pa., chairman.

Anchors for Plows and Derricks.—R. J. Arey, A. T. & S. F. (Coast Lines), Williams, Ariz., chairman.

Methods of Repairing Roofs of Various Kinds.—J. N. Penwell, L. E. & W., Tipton, Ind., chairman.

Methods of Watering Stock in Transit.—J. O. Thorn, C. B. & Q., Beardstown, Ill., chairman.

Protection of Water Tanks and Water Pipes from Action of Frost.—J. P. Canty, B. & M., Fitchburg, Mass., chairman.

Recent Practice in Cofferdam Work.—W. F. Stefens, N. Y. C. & H. R., 5 Vanderbilt avenue, New York city, chairman.

STANDING COMMITTEES.

Pile and Frame Trestle Bridges.—F. S. Edinger, So. Pac., San Francisco, Cal., chairman.

Steel Bridges.—H. H. Eggleston, Cent. Ind., Anderson, Ind., chairman.

Buildings.—E. Du Bois Brown, Chicago, chairman.

Docks and Wharves.—R. Angst, Duluth & Iron Range, Duluth, Minn., chairman.

Water Supply.—B. M. Hudson, St. Louis Kansas City & Col., Union, Mo., chairman.

Fire Protection.—George W. Andrews, B. & O., Baltimore, Md., chairman.

Fences, Crossings and Cattle Guards.—C. S. Corrigan, G. H. & S. A., San Antonio, Tex., chairman.

Preservatives for Wood and Metals.—F. D. Beal, So. Pac., West Oakland, Cal., chairman.

Coaling Stations and Cinder Pits.—W. B. Causey, Chicago & Alton, Bloomington, Ill., chairman.

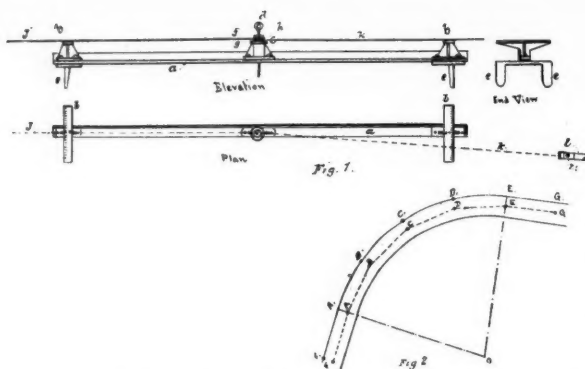
Records and Accounts.—H. M. Henson, Chesapeake & Nashville, Gallatin, Tenn., chairman.

The Smith Curve Lining Gauge

OUR illustration of the curve lining gage represents a tool that insures accurate work under any condition of tracks, giving correct center stakes at every twenty-five feet. It is an instrument that will expedite the work, and can be manipulated by almost any track man in the most complicated easement problems, since simple arithmetic provides for all the calculations involved in its use.

The three views given show the essential features of the device, which is of steel construction, therefore strong and light. The center casting, C, contains a hole for the center pin, D, and the raised castings, B, at either end carry a nickel-plated graduated scale on their top faces. A pair of gage lugs, EE, are secured under the gage bar, A, at each end, making the tool also a track gage.

The center casting has a collar, F, around which two brass rings, G and H, freely rotate. The measuring



THE SMITH CURVE LINING GAGE.

wires, J and K, shown by dotted lines in plan, are attached to these rings by swiveling hooks. The No. 1 gage is graduated for 25 ft. chords and has a capacity to 24 degree curves. The free end of the two wires terminates in a hook which fastens to end pieces, L, which are graduated for different degrees of curvature, and the two end pins (which are similar to the center pin, D,) pass through the hole in L, and exact length of chords is adjusted by the slide, M, which is secured to end piece, L.

The cut shows the instrument being used in the operation of checking up a curve, which is done as follows: Place the gage on top of outer rail on curve, as at A, Fig. 2, opposite point of curve, with center pin up against gage face of rail—the front and rear man also holding the pins up against gage face; the center man swings the gage until the rear wire, AF, crosses the graduation at zero, then the forward wire, AB, shows the degree of curve where it crosses the graduation, which should be noted; after which all three men walk ahead 25 feet, the front man to C, the center man to B and the rear man to A; each holds pin to gage face of the rail, the center man swings gage until the rear wire crosses at zero, then the forward wire

shows degree of curve where it crosses the graduation. This is also noted, and the operation is repeated around the curve to E, which is opposite point of curve. Add all the readings, and divide by the number of readings, the quotient is the degree of curve required in the track.

To line up a curve, place the gage in the center of the track as at A, and drive a stake at F on the tangent 25 ft. back of A, also in the center of the track. Place the gage with center pin at A, with rear man holding the pin to point F, then center man lines the front man until his wire crosses the graduation at the desired degree of curvature. The front man drives a stake or tack at B; then all three men walk ahead 25 feet, the rear man to A and the front man to C, the rear man holding pin at point A, the center man at B and swinging gage until the rear wire crosses zero, when he lines the front man as before, the latter driving a stake or tack at C, the operation being repeated to the end of the curve.

Improvement on the Philadelphia & Reading

TRAVELERS familiar with the lay of the land about the Pennsylvania and Reading stations at Harrisburg will recall the old difficulties of access to each station, from either road, a long detour being necessary in order to pass under the network of tracks separating the two stations. What was needed was an overhead connection, and this has been provided by Chief Engineer Hunter of the Reading, by a covered passageway through which passengers may make the transit in about three minutes. The tracks and stations are shown in plan in Fig. 1, in which the covered platform is shown adjacent to the lobby of the Reading station and passing to a stairway leading to the passenger bridge in the Pennsylvania train shed from which a series of stairways pass down to the trains of the latter road.

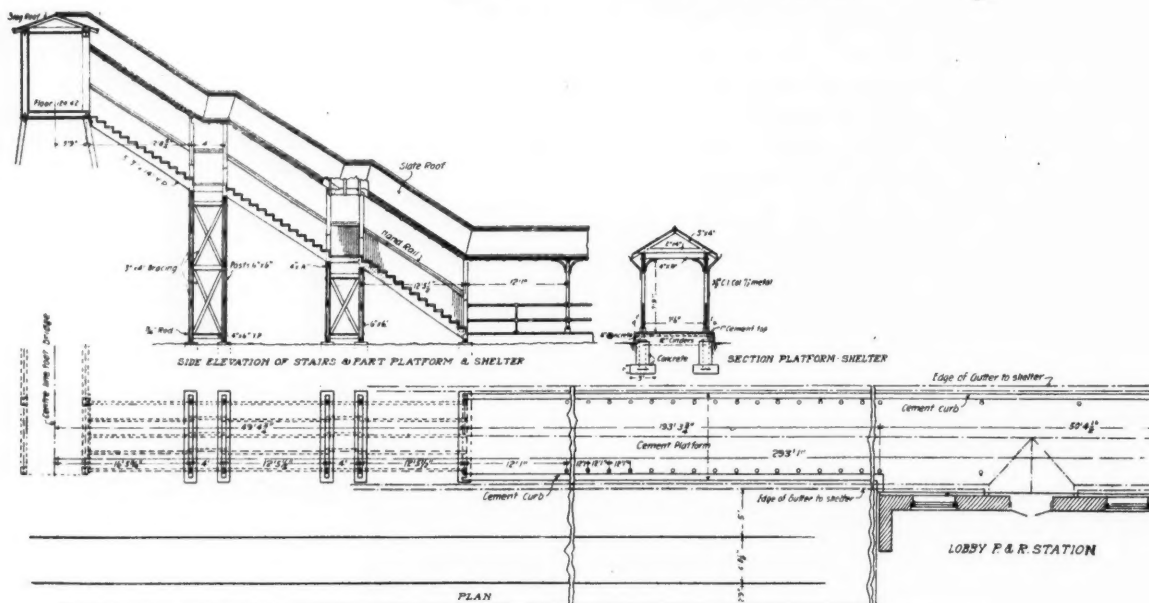


FIG. 2.—STAIRWAY AT BRIDGE, P. & R. AND P. R. R. STATIONS AT HARRISBURG.

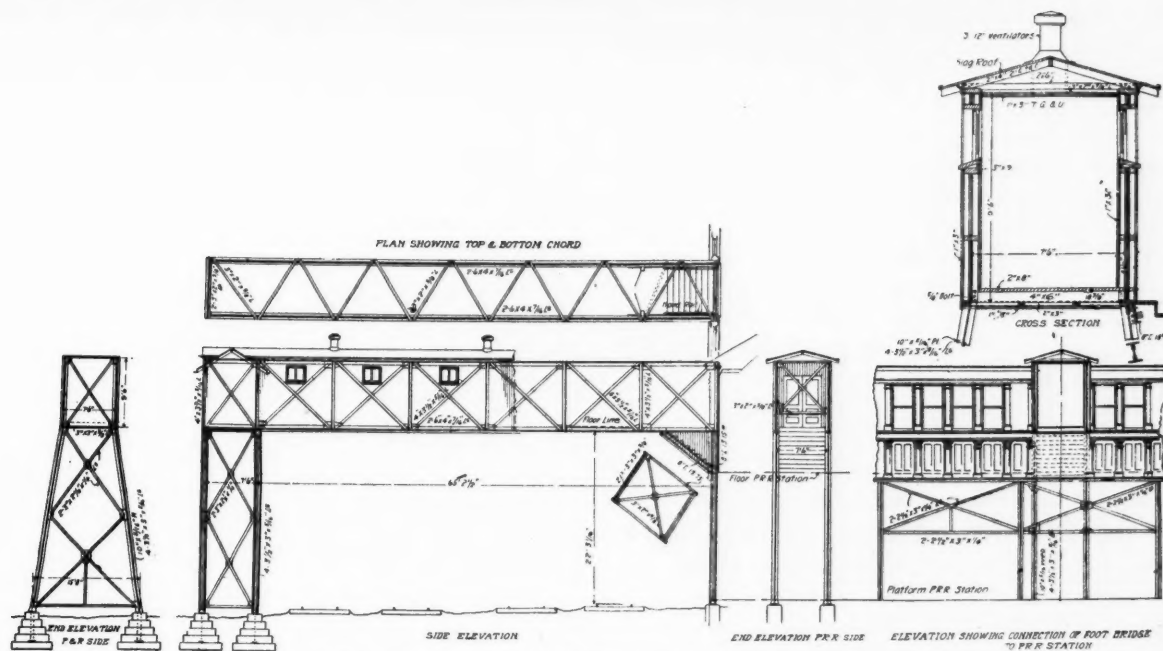


FIG. 3.—ELEVATION OF BRIDGE BETWEEN P. & R. AND P. R. R. STATIONS AT HARRISBURG, PA.

The walk at ground level is constructed of cement laid on cinders, the latter resting on concrete. A neat hand-rail of $1\frac{1}{2}$ inch pipe extends along the sides, effecting a junction with the columns which support the slate roof. These roof columns are made of $3\frac{1}{2}$ inch cast iron pipes, spaced 12 feet 1 inch centers longitudinally and leaving a width of 7 feet in the clear. This walk and canopy is shown in elevation and plan in Fig. 2, which also represents the covered stairway to the passage to train shed. The latter construction is entirely of wood, supported by 6x6 inch posts which are tied by 3x4 inch diagonal braces. A hand rail extends the whole length from which sheathing reaches to the steps.

Fig. 3 shows the construction of the bridge connecting the stairway with the passageway over the tracks in the Pennsylvania train shed. In this case the framing is of steel, the posts being formed of four $3\frac{1}{2}$ x3x5-16 inch angles assembled in box shape with flange inside, while the diagonal bracing is made up of two 3x2 $\frac{1}{2}$ x $\frac{1}{4}$ inch angles, the whole supported on stone piers. The upper framing has a top and bottom chord of two 6x4x7-16 inch angles braced at sides by diagonal cross braces of 4x3 $\frac{1}{2}$ x5-16 angles, and at top and bottom by 3x2x $\frac{3}{8}$

angle diagonals. This construction fills a long felt want and is a fine piece of work from all points of view—artistic as well as utilitarian.

Personals

Mr. W. E. Dauchy has resigned as division engineer in charge of the Culebra works on the Isthmian Canal.

Mr. J. T. Ledger has been appointed roadmaster of the Cincinnati, Hamilton & Dayton at Lima, O., in place of Mr. W. M. Connors, resigned.

Mr. Geo. L. Dillman has resigned as supervising engineer of the Western Pacific at San Francisco, Cal.

Mr. G. P. Troutman has resigned as assistant division engineer of the Lehigh Valley at Centralia, Pa.

Mr. William Rodman has been appointed as roadmaster of the Panama Railroad at Colon, Panama.

Mr. Jas. F. Parr has been appointed assistant engineer of the Missouri Pacific at St. Louis, Mo.

Mr. Wilkie Woodard has been appointed chief assistant construction engineer of the Missouri Pacific.

Mr. H. S. Moore has been appointed chief engineer of the Missouri, Oklahoma & Gulf, with office at Muskogee, I. T., to succeed Mr. Frank C. Faust, resigned.

Mr. W. L. Elkins has been appointed assistant engineer of the Michigan division of the Vandalia Lines. Formerly Mr. Elkins was assistant on the engineering corps.

Mr. W. H. Dufrane, formerly roadmaster of the Chicago & Northwestern at Clintonville, Wis., has been appointed roadmaster of the Sierra Railway of California at Jamestown, Cal.

Mr. J. G. Sullivan, division engineer of construction of the Canadian Pacific lines at Winnipeg, Man., has been appointed assistant engineer of construction on the Isthmian canal.

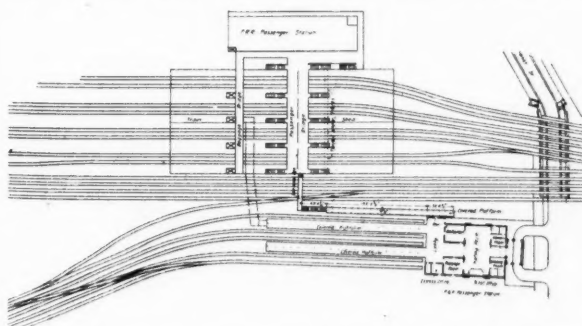


FIG. 1.—PLAN OF BRIDGE AND STATIONS AT HARRISBURG PA., P. & R. AND P. R. R.

Mr. Thomas Ahern, roadmaster of the Southern Pacific at Oakland Pier, Cal., has been appointed assistant to the district engineer of maintenance of way at San Francisco, Cal.

Mr. J. M. R. Fairbairn has been appointed acting division engineer of the Eastern division of the Canadian Pacific, with offices at Montreal, Can., vice Mr. D. MacPherson, resigned.

Mr. E. M. Grime, division engineer of the Chicago Great Western at Clarion, Ia., has been transferred to St. Paul, Minn., in a similar capacity, succeeding Mr. H. W. Church, resigned to engage in other business.

Mr. J. B. Berry, chief engineer of the Union Pacific, has been appointed a member of the board of consulting engineers of the Isthmian Canal Commission.

Mr. Geo. C. Millet has been appointed general superintendent and chief engineer of the Ohio River & Columbus, with headquarters at Ripley, O., effective on September 1.

Mr. L. J. McIntyre, formerly engineer of the New York terminal division of the Erie, has been appointed assistant engineer of the Chicago & Northwestern at Chicago, Ill.

Mr. Wm. H. Bush, formerly assistant engineer of the Missouri Pacific at St. Louis, Mo., has been appointed engineer maintenance of way of the Kansas City Southern at Pittsburg, Cal.

Mr. Wm. R. Strickland has resigned as assistant engineer in the maintenance of way department of the New York Central & Hudson River to become assistant to the secretary of J. G. White & Co., New York.

Mr. J. O. Hackenberg has been appointed supervisor of the Pennsylvania at Kittanning, Pa., in the place of Mr. R. G. Goldsborough. Mr. E. W. Lehman has been appointed supervisor of the Philadelphia & Erie division.

Mr. E. H. Pfafflin has been appointed engineer of way and structures of the Southern Indiana, with offices in the Grand Central Station, Chicago, succeeding Mr. F. W. Ranno, resigned, effective on September 1.

Mr. Geo. H. Burgess, formerly assistant engineer of the Northwestern system of the Pennsylvania Lines at Pittsburg, Pa., has been appointed assistant engineer of the Erie in charge of the reconstruction of the terminal docks at Jersey City, N. J.

Mr. Thos. J. Wyche, resident engineer of the Union Pacific at Omaha, Neb., has been appointed supervising engineer of the Western Pacific, in charge of the construction of 282 miles of that road from Salt Lake, Utah, west.

Mr. Homer W. Loomis, heretofore roadmaster of the Dunkirk, Allegheny Valley & Pittsburg at Dunkirk, N. Y., has been appointed roadmaster of the Lansing division of the Lake Shore & Michigan Southern at Hillsdale, Mich.

Mr. G. L. McDougald has been appointed signal engineer of the Chicago & Alton, with headquarters at

Bloomington, Ill., succeeding Mr. W. R. Daves, resigned. Mr. McDougald formerly has been connected with the Long Island Railroad.

Mr. E. G. Lane, division engineer maintenance of the New Castle division of the Baltimore & Ohio at New Castle, Pa., has been appointed acting engineer maintenance of way at Pittsburg, Pa., in the place of Mr. H. H. Temple, who is ill.

Mr. B. Douglas has been appointed tunnel engineer of the Michigan Central, Mr. J. C. Mock, electrical engineer, and Mr. A. C. Everham, terminal engineer, to assist in the construction of the tunnel under the Detroit river at Detroit.

Mr. J. J. Harding, assistant engineer of the Chicago, Milwaukee & St. Paul at Chicago, has been appointed engineer of masonry construction, with offices at Chicago, to succeed Mr. J. C. Hain, resigned. Mr. J. H. Pryor has been appointed assistant engineer in the place of Mr. Harding.

Mr. C. L. Barnaby, assistant engineer of maintenance of way of the Chicago Terminal division of the Grand Rapids & Indiana, has been appointed engineer of maintenance of way of the Southern division at Ft. Wayne, Ind., succeeding Mr. B. H. Hudson, Jr., promoted.

Mr. E. J. Nichols, formerly engineer maintenance of way of the New York, Texas & Mexican, and the Gulf, Western Texas & Pacific at Victoria, Texas, has been appointed resident engineer of the Victoria division of the Galveston, Harrisburg & San Antonio at Victoria.

Mr. A. C. Morse, assistant chief engineer of the Atchison, Topeka & Santa Fe at Topeka, Kan., has been transferred to Los Angeles, Cal., as acting chief engineer of the Coast Lines, in the place of Mr. R. B. Burns, who has been granted a leave of absence, owing to ill health.

Mr. Frank Lee, formerly assistant engineer of the Canadian Pacific at Winnipeg, Man., has been appointed division engineer of the Central division at Winnipeg, to succeed Mr. J. E. Schwitzer, transferred. Mr. Lee was at one time with the engineering department of the Chicago & Northwestern, from which service he went to the Canadian Pacific as signal engineer.

Mr. R. B. Burus, chief engineer of the Coast Lines of the Atchison, Topeka & Santa Fe Railway Co., has been granted a leave of absence until January 1, 1906, for a much needed rest. His many friends will be glad to know that he is not broken down, and that he will resume his duties the first of the year.

Mr. D. Y. Swatey, assistant engineer of the Southwest system of the Pennsylvania Lines, has been appointed engineer of the Northwest system at Pittsburg, Pa., in the place of Mr. Geo. H. Burgess, resigned. Mr. C. E. Rowe, assistant engineer of the Southwest system at Pittsburg, will assume the duties formerly performed by Mr. Swatey.

Mr. R. E. Dougherty has been appointed resident engineer of the New York Central & Hudson River in

charge of construction in the exterior zone, south of Poughkeepsie on the main line, Newburgh on the West Shore, Putnam Junction on the Harlem Railroad and including the Putnam Railroad and its branches, taking effect on Sept. 1.

Mr. E. P. Hawkins has been appointed roadmaster of the Third and Fourth divisions of the Mobile & Ohio, with offices at Murphysboro, Ill., vice Mr. Charles McEniry, resigned. The jurisdiction of Mr. J. S. Cheatham, supervisor of bridges and buildings of the Third and Fourth divisions, has been extended to include the First division, with the exception of the Oklahoma branch, to take effect September 1.

Mr. F. W. Van Etten has been appointed superintendent of telegraph of the Southern Indiana, with offices at the Grand Central Station, Chicago. Mr. F. S. Lewis, formerly superintendent of the Illinois Southern, has been appointed superintendent of the Southern Indiana, with offices at Terre Haute, Ind. Mr. F. W. Smith has been appointed trainmaster at Terre Haute, in place of Mr. J. C. Collins, resigned; effective on September 11.

Mr. Guy Scott, formerly assistant engineer of the Cleveland & Pittsburg division of the Northwest system of the Pennsylvania Lines, has been appointed assistant engineer of the Chicago Terminal division at Chicago, succeeding Mr. C. L. Barnaby, transferred. Mr. E. A. McCrea, formerly assistant engineer of the Southwest system, has been transferred to Wellsville, O., as assistant engineer of the Cleveland & Pittsburg division of the Northwest system in the place of Mr. Scott. Mr. W. A. Hawley has been appointed assistant engineer of the Southwest system at Richmond, Ind., to succeed Mr. McCrea.

Mr. W. S. Newhall has resigned as chief engineer of the Wabash to become a member of McMyler Manufacturing Company at Cleveland, O. Mr. A. O. Cunningham, for about three years past bridge engineer of the Wabash and formerly connected with the American Bridge Co., has been appointed chief engineer, with office at St. Louis, to succeed Mr. Newhall, and the position of bridge engineer will be abolished. Mr. H. M. Cryder will continue as assistant engineer. Mr. Newhall was appointed chief engineer of the Wabash in June, 1902, previous to which date he was chief engineer of the Wheeling & Lake Erie.

Second Vice-President Mudge, of the Chicago, Rock

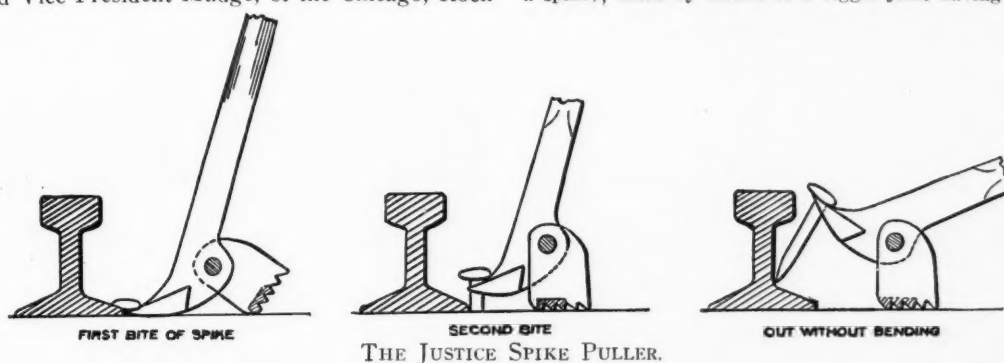
Island & Pacific, has issued the following announcements relative to the reorganization of the engineering department of that road. Effective on August 22, the engineering organization will be as follows: One chief engineer, reporting to the second vice-president; such principal assistant engineers as may be necessary, reporting to the chief engineer; two engineers of maintenance, reporting to their respective general managers and to the chief engineer; four district engineers, reporting to their respective general superintendents and to the engineer of maintenance; such assistant engineers as may be necessary, reporting to the district engineer. The following have been appointed district engineers: Mr. J. M. Brown, Davenport, Ia.; Mr. G. Davis, Cedar Rapids, Ia.; Mr. W. H. Davisson, Topeka, Kan.; Mr. H. G. Clark, Little Rock, Ark.

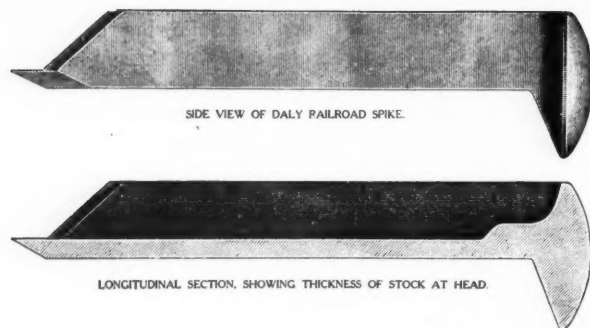
The Justice Spike Puller

A spike puller that removes a spike without the distortion due to the action of the old claw-bar is shown in our illustration. This device has a swiveling fulcrum, the use of which gives a constant lever arm, and one always normal to the line of action after the spike is started. The fulcrum for the first or initial pull is seen to be near the point of greatest leverage, which if continued to the full removal of the spike would bend the same as is done by the old bars, and to avoid that result is the purpose of the new device. It not only never bends a spike, but removes it in much less time than by any other means. The bar is made by Philip S. Justice & Co., Philadelphia, Pa.

The Daly Railroad Spike

The railroad spike has been influenced by fewer changes in form than any other detail connected with track construction and maintenance, the reason for which is found in the necessity for retaining the essential general shape which does admit of alteration. There has, however, been an evolution going on, which while preserving the general appearance of the old solid rectangular affair, has culminated in a production entirely different from anything heretofore brought out for securing the rail to the tie. The new spike is known as the Daly, and as shown in the illustration, it will be seen to be of channel section, with a point that is designed to enter a tie with the least possible distortion of the fiber. It has, owing to its channeled construction, six bearing faces in the wood instead of four as in the square spike, and therefore gives a greater resistance to backing out. Its holding power against pull has been shown by dynamometer test to be thirty-seven per cent greater than the solid spike, and in cedar ties forty per cent greater. In the test of this spike for lateral resistance against thrust (which is the crucial test of a spike), made by means of a toggle joint having an almost



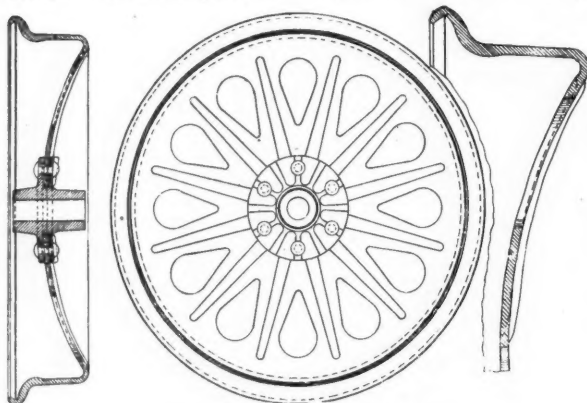


THE DALY RAILROAD SPIKE.

irresistible power, the force was exerted between the Daly spike and the square article driven in the same tie. In these tests the new spike remained in position as driven without a sign of displacement, while the square spike was bent so badly as to be useless for driving. The sectional view shows the reinforced portion under the lip, which safeguards against cutting in the throat. The pamphlet sent out by the Frost Railway Supply Company describing this article refers to it as "not a theory but a spike," and it certainly appears to bear them out.

A New Pressed Steel Wheel

A pressed steel wheel for hand cars and light equipment used about industrial plant is the subject of an illustration that will bear inspection, for the reason that it has some points never heretofore embodied in wheels of the kind, and which have been protected by letters patent. There are several features which are specially worth mention, and which place this wheel in the front rank of wheels formed of a solid steel disk. The hub is of malleable iron made up of two pieces, one of which is the hub itself having a flange at the inside face $1\frac{3}{4}$ inches deep by $\frac{3}{8}$ inch thick on which is shouldered the center or plate of the wheel which has a hole $2\frac{1}{4}$



A NEW PRESSED STEEL WHEEL.

inches in diameter fitting the hub. The second part forming the hub is the ring of the same dimensions as the flange, fitting outside of the wheel plate which is secured between flange and ring and held by six half-inch rivets.

The wheel is made of $\frac{1}{4}$ -inch steel plate, pressed to shape, the center being perforated and ribbed. The flange on the hub is so located as to bring the plate immediately under the point of contact between the rail and tread of the wheel. The flange and tread has a reinforcement at the point of maximum wear, to a thickness of one-half inch, which is formed by upsetting the metal by pressure—not impact—in a machine designed for the purpose and also patented. For lightness, strength, and the pains taken to insure durability this wheel is attracting the attention of those interested in good work of the kind. It is made by the Kalamazoo Railway Supply Co., Kalamazoo, Mich.

The Use of High Speed Steel for Rail Drilling

High speed, or what is known as air hardening steel, has within a few years completely revolutionized machine shop practice. Cutting speeds have been trebled and output more than doubled. Until recently it has not, however, been successfully used for drilling purposes. The principal reason for this has been that manufacturers of twist drills seemed unable to furnish a drill bit of this material and guarantee its reliability. Also the percentage of loss in manufacture which occurs with steel of this nature is so great that the price to the purchaser would naturally be increased to such an extent that the advantages would be over!adowed.

The Rich flat drill bit has recently been placed on the market and is the first successful application of high speed steel for track drilling purposes. Various trials have demonstrated that one of these drill bits outwear ten to fifteen twist drills and each is absolutely guaranteed by the manufacturer, so that the buyer is called upon to take no risk whatever.

The form of the flat bit is shown in the illustration. Its construction is simple, but it is extremely efficient and embodies many strong features. It is made of a rolled bar of carefully selected air hardening steel. Suitable lengths are then cut and put through a highly refined process—the result of long and costly experiments. They are carefully tempered throughout the entire length, for they are designed to be usable up to within two inches of the butt. They are next ground and ready for use. During the process of manufacture frequent tests are made and any showing the slightest defect are thrown out.

Some interesting trials have been made which indicate the superiority of air hardening steel for drilling purposes, and show the remarkable endurance which it exhibits in this class of work. At one of the Carnegie Steel Co.'s rail mills a set of six Rich flat drills each drilled 1,600 holes 1 inch in diameter in 80-pound steel rails without being reground. Fifty holes with the ordinary twist bit would be considered a very good performance.

That a great deal depends on the proper tempering and refining of air hardening steel in the production of a drill bit was made evident by a test conducted at the mill of the Illinois Steel Co. at South Chicago where the Rich drill was tested with forged flat drills of the same material, where it was found that the Rich bit drilled twice as many holes at fifty per cent greater speed.

Another interesting experiment was made on armor plate in the navy yard at New York. The Rich drill bit drilled ten holes in the armor plate turrets of the battleship Connecticut $1\frac{1}{4}$ inches in diameter without resharpening, while eight twist drills were used without finishing one hole. These and other tests convincingly indicate the ability of air hardening steel, as developed in the Rich flat bit, to withstand the severest service under high speed conditions with coarse feeds. The extreme hardness of these drills and the consequent economy

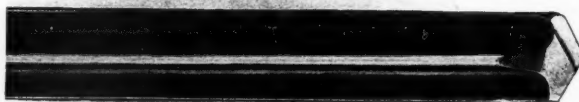


FIG. 1. RICH FLAT DRILL BIT.



FIG. 2. SPINDLE FOR RICH FLAT BIT.

ensuing from their use will doubtless augment their use for track work.

The shape of the Rich flat drill is such that a special chuck is made necessary. This is furnished by the same company and is an excellent example of the machinist's art, being considerably above the average. The jaws, which are adjustable, are so arranged that the bit is held dead true and absolutely firm by means of a clamping unit. The end of the bit is supported by an adjustable thrust block within the barrel, which may be changed to compensate for the wearing off of the point in grinding. One important feature which reduces the liability of the drill breaking is the depth of the barrel which allows the bit to recede into it until only enough is presented to penetrate the work before it.

A special Rich spindle, chuck and drill for use on Paulus drills is illustrated in the half-tone cut. Paulus drills are now to be had thus equipped if desired. The spindle is interchangeable with the former style which accommodated the straight shank twist drill; so that Paulus drills now in use may be supplied with the Rich chuck and drill, the change being so simple it may be made by any one, the only requirements being to pull out the old spindle and insert the new one. The added efficiency may be thus secured at a slight expense.

This is one of the recent notable accomplishments in the

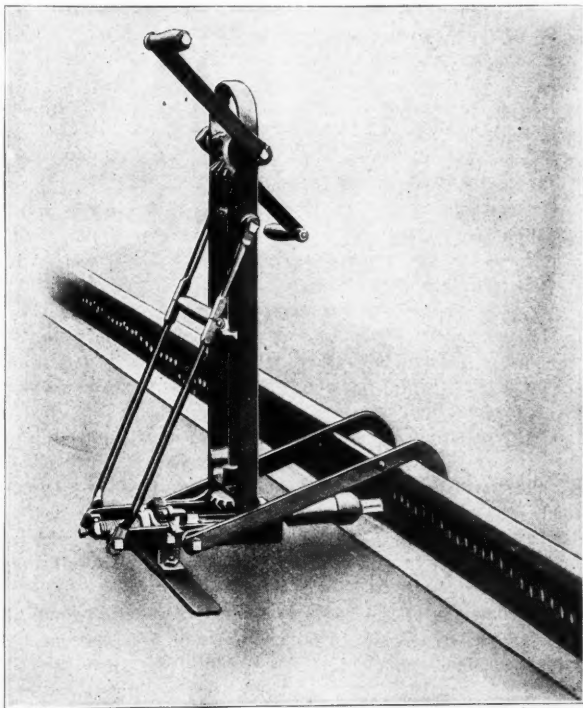


FIG. 3. PAULUS TRACK DRILL EQUIPPED WITH A RICH FLAT BIT.

furthering of economy in track work and will doubtless command considerable attention.

The Buda Foundry & Manufacturing Company of Chicago are the exclusive selling agents for Rich chucks and spindles for track drilling and Rich high speed drills for track drilling purposes.

Notes of the Month

During the last few months the Independent Pneumatic Tool Company, Chicago, have received an unprecedented number of orders for the Thor pneumatic tools. There has been a great demand for these by railroads, boiler shops, foundries and bridge and iron works.

RUST; HOW TO PREVENT IT. This is the title of a neat pamphlet issued by the Detroit Graphite Mfg. Company, Detroit, Mich. The front cover has a half-tone of a rusted I-beam, while the inside has a large number of pictures of structures which are painted with "Superior Graphite Paint" to prevent the decay of the steel from rust.

The prizes offered by Engineering News and the Cement Age of New York for the best papers on "The Manufacture of Concrete Blocks and Their Use in Building Construction" have just been awarded by the jury, which was composed of Messrs. Robert W. Lesley, past-president of the American Cement Manufacturers' Association; Richard L. Humphrey, president of the Cement Users' Association; and Prof. Edgar Marburg, secretary of the American Society of Testing Materials. The first prize of \$250 was won by a paper by Mr. H. H. Rice of Denver, Colo., secretary of the American Hydraulic Stone Company. The second prize of \$100 is given to a paper by Mr. Wm. M. Torrance, C. E., of New York City, assistant engineer in charge of concrete-steel design for the Hudson Tunnel Companies.

Consul Halstead, of Birmingham, calls attention to the carelessness of American business houses in the matter of advertising. He says: A certain American magazine is sold here, and judging from what the newsdealers in Birmingham tell me, it has a fair circulation. It carries its American advertisements in its English edition. They constitute one of the attractions which sell the magazine. These advertisements could be useful in developing American trade in Great Britain, but in every issue of this magazine there are a number of advertisements of American articles, the manufacturers of which have English agencies, and yet the advertisements do not have the addresses of the English agents. I feel certain that these addresses are not put in because the American manufacturers are not aware that their advertisements are carried in the English edition of the magazine in question.

Consul-General Holloway, of Halifax, transmits the following from the Canadian Manufacturer: During the next five years Canada will probably increase its railway equipment by the construction of some 7,000 to 10,000 miles of new railroads. Whether this estimate is below or above what will prove to be the facts it is certain that the Dominion is entering upon a period of railroad construction which it has not yet experienced. Beginning with the new transcontinental project of the Grand Trunk Pacific, seconded by the plans of the Canadian Northern, and the inevitable growth of the Canadian Pacific, the total railroad construction in Canada, particularly in the great northwest, is certain to be large. There is room in western Canada for 50,000 miles of railway. Today there are scarcely more than 5,000 miles.

The International Acheson Graphite Company of Niagara Falls, N. Y., with the recent completion of a large extension

equipped with the most modern electrical and mechanical appliances and machinery, has doubled the capacity of its plant for creating graphite in the electric furnace, and has closed a contract with the Niagara Falls Power Company for another 1,000 horse power of electrical energy in addition to the 1,000 horse power previously used. The commercial importance of this artificial graphite may be estimated from the fact that the United States Geological Report for 1904 states that for that year the value of Acheson graphite produced was \$217,790, while all the graphite mined in this country amounted merely to \$341,372. New York state, which is considered rich in deposits, according to the official report of 1904 produced natural graphite worth \$119,509. Acheson graphite is largely used in the manufacture of metal protective paints, dry batteries, stove polish, packing and as a lubricant. The electrochemical processes also consume an extensive supply.

Consul Ernest L. Harris, of Chemnitz, reports that it is contemplated by the German government to use wireless telegraphy to prevent accidents. He writes: Recent disastrous railway accidents in Germany will probably lead to the general introduction and use of wireless telegraphy on all the state railways. Two years ago exhaustive practical experiments were commenced and continued until recently on the military railway leading from Berlin to Zossen. The telegraph stations on the route were each fitted up with a transmitter and receiver, while the trains were equipped with the same apparatus. The ordinary telegraph wires along the track were also used to facilitate the work. The experiments proved conclusively that the different stations could at any time communicate with a train running at full speed and warn it of impending danger. The use of wireless telegraphy in this connection would especially safeguard trains on one-track railways from danger. It is not expected that the expense of supplying stations and passenger trains with the necessary apparatus will be much beyond the budget allowed each year for the purpose of repairing old signals and introducing new appliances and inventions which have for their aim the protection of life and limb in railway travel.

Mr. H. Allaway, in the special financial column of the New York Tribune, says: "The extraordinary appreciation of New York's Interborough Subway seems sure to be duplicated, the Chicago property being a carrier of freight in contrast with the exclusive passenger traffic of the New York company. Against the New York Interborough Company's \$35,000,000 capital have been issued \$35,000,000 city bonds, and it is understood they have issued \$10,000,000 notes for equipment. They own the Subway and a lease of the Manhattan Railroad Company on a 7 per cent guarantee. The Interborough Rapid Transit Company was formed with a capital of \$25,000,000 to complete and operate the Subway, so that in round numbers they have \$35,000,000 bonds, \$35,000,000 Interborough stock and \$25,000,000 Interborough Rapid Transit Company stock—a total of \$95,000,000—and Interborough Rapid Transit stock is quoted at 215 per share. Upon the other hand, the stock of the Chicago Subway is \$40,000,000, and this is a holding company, having issued about \$17,000,000 bonds (out of \$30,000,000 authorized), and has thirty-three miles of tunnel completed, connecting with all the depots, wholesale houses, hotels and shipping docks of Chicago. Comparing receipts, the New York company carries passengers at five cents each, down in the morning and back in the afternoon (six to ten miles) and does comparatively little at night, while Chicago Subway handles freight, and the lowest revenue it receives is sixty cents per ton for hauling a distance of one mile—and the system will be in use 24 hours a day. Now, any railroad will haul soft coal 200 miles at three mills per ton per mile, or sixty cents per ton for 200 miles, and consider it profitable. There is no city in the world where business is so congested in a mile square as in Chicago."

Consul Mahin, of Nottingham, reports that a successful fire alarm has been invented in England. Experiments warrant the belief that it will prove of great value in preventing the spread of fires. He writes: A new automatic fire alarm was tested in this city this week. In a large room of a hotel, where three of the alarms, small instruments, were attached to the ceiling, a quantity of waste on a tray was saturated with methylated spirit and set on fire. In twelve seconds a gong attached by electric wires to the instruments on the ceiling sounded an alarm. Only the raising of the temperature to a certain degree (which may be varied according to circumstances) is required to cause the alarm. The instrument is merely a scientific application of the fact that heat causes expansion. As soon as the metal in the little apparatus becomes affected by the rise in temperature which must inevitably take place immediately a fire breaks out, it expands, completes an electric circuit, and the bell, which may be placed anywhere—at the fire station if desired—rings. An ingenious arrangement regulates the degree of heat at which the instrument shall give warning. In a room where, by reason of the work carried on, the temperature is ordinarily high, the point at which the warning shall be given must obviously be proportionately higher. A turn of a little clock hand is all that is required to effect it. It is claimed that the instrument may be made so sensitive that merely breathing upon it will cause the alarm to be given.

The test at the hotel is reported to have been entirely successful. It is also stated that several fires have started in rooms where the alarm has already been installed, and in every case were so quickly extinguished that the damage was trifling. The patentees are the Pearson Fire Alarm Company (Limited), 62 King William street, London.

Consul-General Halloway, of Halifax, transmits the following information for the benefit of American contractors.

PROVINCE OF MANITOBA.

T. S. Menarey, Melita, will receive tenders for the purchase of 7,000 school debentures.

J. C. Gilson, Winnipeg, will receive tenders for one turbine pump, with motors, for the city water works.

G. E. Graham, Winnipeg, is inviting tenders for the purchase of the following buildings in the Canadian Pacific Railway Company's yards in that city: Round house, machine shop, blacksmith shop and car shop.

The city of Winnipeg is asking for tenders for the construction of a city hall, to cost about \$200,000. Further information may be obtained by addressing the architect, Mr. S. Hooper, McIntyre block, Winnipeg.

Tenders addressed to Ald. J. C. Gibson, chairman fire, water and light committee, for supplying one turbine pump, with electric motor, for the city water works, will be received by C. J. Brown, city clerk, Winnipeg.

NORTHWEST TERRITORY.

The town clerk of Qu'Appelle will receive tenders for the erection of a town hall.

The department of marine and fisheries, Ottawa, will receive tenders for fog-alarm machinery.

The department of public works, Ottawa, will shortly call for tenders for the construction of barracks in Toronto. In all, there will be twenty brick buildings, thoroughly fireproof.

The department of marine and fisheries, Ottawa, is inviting tenders for keeping a wrecking steamer and tender with all up-to-date wrecking plant, including pump, diving suits, anchors, chains, boats and other plant.

The chairman of the board of control, city hall, Toronto, is inviting tenders for the installation of two 5,000,000 imperial gallon turbine pump and steam turbines, and also for the supply of fire hydrants, valves and cast iron pipe.

The department of public works, Ottawa, are inviting tenders for the construction of a landing pier at Peel Head Bay, Quebec.

